

Remarks/Arguments:

Claims 1-6 are pending in this application.

Claims 1-6 stand rejected under 35 U.S.C. § 103(a) as unpatentable over WO 00/09441 ("Abbot '441") in view of U.S. Patent No. 4,999,133 ("Banquy"). Claims 1-6 also stand rejected under 35 U.S.C. § 103(a) as unpatentable over WO 03/016250 ("Abbott '250") in view of Banquy. The applicants respectfully traverse these rejections and respectfully submit that the currently pending claims are patentable over the references cited in the Office Action for at least the reasons set forth below.

Features of Amended Independent Claim 1

The applicants' invention, as claimed in independent claim 1, includes the following features which are not obvious in view of the cited references, namely:

a) subjecting a hydrocarbon feedstock to steam reforming by...

iii) forming a secondary reformer feed stream comprising the primary reformed gas and the second hydrocarbon stream . . .

v) using the resultant secondary reformed gas to heat the tubes of the heat exchanger reformer, thereby producing a partially cooled reformed gas . . .

d) incorporating at least part of said tail gas into the secondary reformer feed stream before the partial combustion thereof.

Response to Rejections Based on Abbott '441 in view of Banquy

The Office Action has rejected claims 1-6 as obvious over Abbott '441 in view of Banquy. Abbott '441 describes a process wherein a feedstock/steam mixture is subjected to primary reforming over a catalyst disposed in heated tubes in a heat exchange reformer. The resultant primary reformed gas is subjected to secondary reforming by partially combusting the primary reformed gas with an oxygen-containing gas. The resultant partially combusted gas is then brought towards equilibrium over a secondary reforming catalyst, and the resultant secondary reformed gas is used to heat the tubes of the heat exchange reformer.

Significantly, the applicants submit that Abbott '441 is explicit that there should be no addition of hydrocarbon to the primary reformed gas (see e.g. Abbott '441, claim 1, part (b),

first clause and page 2, line 31). Thus, in the process of Abbott '441, no hydrocarbon feedstock by-passes the primary reforming stage. In order to control the stoichiometry of the synthesis gas, carbon dioxide is separated from the secondary reformed gas before or after its use for the synthesis of carbon containing compounds, which is then recycled to the primary reformer feed. For example, in at least one embodiment described in Abbott '441 adapted for Fischer Tropsch synthesis, the recycled carbon dioxide is part of the tail gas from a Fischer-Tropsch synthesis process, which is added to the natural gas feedstock prior to desulphurisation of the latter. Thus, as disclosed, the tail gas is fed to the primary reforming step and not the secondary reforming step.

Among the criteria for establishing a *prima facie* case of obviousness, is that "the prior art reference (or references when combined) must teach or suggest all the claim limitations." See M.P.E.P. § 2143. Thus, the applicants submit that the following features of the claimed invention are either not present in Abbott '441 or are not rendered obvious by the combination thereof:

(a) forming a secondary reformer feed stream comprising the primary reformed gas and the second hydrocarbon stream, (claim 1 (a) part (iii)), and

(b) incorporating at least part of said tail gas into the secondary reformer feed stream before the partial combustion of thereof, (claim 1(d)).

The Office apparently seeks to supply the feature (a) by citing to Banquy. However, the applicants contend that based on the teaching of Abbott '441, one of ordinary skill in the art would not contemplate adding the feature (a) to Abbott '441 by by-passing hydrocarbon around the primary reforming step in view of the explicit statements in '441 that no hydrocarbon should be added to the primary reformed gas. The applicants contend that it would be improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743 (Fed. Cir. 1983).

Further, with respect to feature (b), Abbott '441, as noted above, does not disclose this feature. More significantly, the Office Action does not cite to Banquy to supply this feature either, as this feature is absent from Banquy also. Instead the Office asserts that Banquy teaches splitting "the feedstock into two fractions," and that it would therefore have been obvious "to preheat the second fraction with the reformed gas obtained from the first fraction to obtain a feed stream suitable for the partial combustion." (Office Action, page 5). Based on

this point above, because neither reference discloses feature (b), a *prima facie* case of obviousness has not been made.

The applicants submit that the feature of incorporating at least part of said tail gas into the secondary reformer feed stream before the partial combustion thereof is not an obvious modification within the disclosure of Abbott '441. As stated in the present application, Fischer-Tropsch tail gas is liable to contain a significant amount of carbon monoxide. The applicants have realized that if this is added to the feedstock prior to primary reforming in a heat exchange reformer, as according to Abbott '441, the carbon monoxide can undergo the exothermic methanation reaction resulting in a faster increase in temperature of the gas undergoing reforming than if the tail gas had not been added. The temperature difference between the gas undergoing reforming and the heating medium is thus decreased, which has the consequence of increasing the size of the heat exchange reformer for a given reforming duty. Increased vessel size is undesirable, not at least because it increases fabrication costs. Therefore, the applicants contend that there is no suggestion of this problem or the solution presented by the applicants' claimed features anywhere in Abbott '441.

Moreover, Banquy relates to a reforming process, directed at methanol synthesis in particular, using a traditional fired steam reformer and a secondary reformer in which part of the hydrocarbon feed by-passes the steam reformer. There is no suggestion whatsoever in Banquy that the same process may be applied to a process using a heat exchange reformer as presently claimed, wherein the secondary reformed gas is used to heat the catalyst filled tubes of the primary reformer (see claim 1(a) part (v)). This difference is important.

In Banquy, by-pass of the fired steam reformer transfers a portion of the hydrocarbon reforming duty to the secondary reformer and allows a reduction in size of the steam reformer, with the consequential cost savings.

However, because the present invention requires the secondary reformer to provide the heating medium for the primary reformer, by-passing hydrocarbon to the secondary reformer has the effect of reducing the temperature difference between the heating medium and the gas undergoing reforming. This results in an increase in the size of the heat exchange reformer, versus one with no by-pass as disclosed in Abbott '441, for the same reforming duty. Accordingly, the applicants submit that the one of ordinary skill in the art faced with the heat

exchange reforming process of Abbott '441 would not include the by-pass of Banquy because it would result in an increased reformer size for the same duty.

In contrast, as stated in the application, the applicants have found surprisingly that operation at low overall steam ratios with economical reforming of the hydrocarbon feedstock and without carbon deposition on the catalyst, may be achieved by dividing the feedstock into two streams, mixing the first stream with steam and feeding it to the primary reformer and feeding the second stream to the primary reformed gas before secondary reforming along with at least part of the tail gas from the Fischer-Tropsch process. The steam ratio is therefore lower overall but still sufficiently high in the primary reforming step to avoid carbon deposition.

Therefore, for at least the reason that all of the features of the applicants' claims are not taught, disclosed or suggested in Abbot '441 and Banquy, either alone or in their combination, the applicants contend that the Office has failed to establish a *prima facie* case of obviousness. Further, the applicants contend that one of ordinary skill in the art would not have modified Abbott '441 in view of Banquy, for at least the reasons set forth above, to produce the applicants' claimed invention. Therefore, the applicants submit that independent claim 1 is patentable over Abbott '441 in view of Banquy for at least these additional reasons.

The applicants further submit that claims 2-6, which are dependent on claim 1, are patentable over Abbot '441 and Banquy for at least the same reasons that claim 1 is patentable, but may also be separately patentable for additional reasons as well.

Response to Rejections Based on Abbott '250 in view of Banquy

The Office Action rejects claims 1-6 as obvious over Abbott '250 in view of Banquy. In the rejection of these claims under 35 U.S.C. §103(a), the Abbott reference (WO 03/016250) is being asserted as prior art under 35 U.S.C. § 102(e). The applicants point out that Application Serial Number 10/534,239, and WO 03/016250 were, at the time the invention of Application Serial No. 10/534,239 was made, owned by Johnson Matthey PLC. Therefore, Abbott '250 cannot be applied in an obviousness rejection based on 35 U.S.C. § 103(c).

For completeness, the applicants note that a search of the family of WO 03/01650 uncovered a document listed as GB 0120071D filed on October 10, 2001. This document was determined to be merely a reference to the British priority application, which served to give a

priority date and was later abandoned without publication. Hence, the GB0120071 application did not publish and therefore does not constitute prior art.

Conclusion

In view of the arguments presented above, the applicants respectfully submit that the application is in condition for allowance. Notice to this effect is earnestly solicited.

Respectfully submitted,



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